

CLAIMS

1. A method for coating a substrate with an ionomer comprising the steps of:

applying a layer of a stable foam to at least one surface portion of the substrate; the stable foam having been prepared by mixing a foamable ionomer-containing fluid with a gas to form a mixture and agitating the mixture to yield the stable foam; and

drying the layer of stable foam, thereby yielding an ionomer-coated substrate.

2. The method of claim 1 wherein the layer of stable foam is applied to the at least one surface portion of the substrate in a continuous manner.

3. The method of claim 1 wherein the layer of stable foam is applied to the at least one surface portion of the substrate at a uniform thickness.

4. The method of claim 1 wherein the layer of stable foam is applied to the at least one surface portion of the substrate at a thickness ranging from 25 μm to 2 mm.

5. The method of claim 4 wherein the layer of stable foam is applied to the at least one surface portion of the substrate at a thickness of about 250 μm .

6. The method of claim 1 wherein the layer of stable foam is applied to the at least one surface portion of the substrate in an amount ranging from 0.5 to 25 grams of ionomer per square meter.

7. The method of claim 1 wherein the layer of stable foam is applied to the at least one surface portion of the substrate in such an amount as to yield a dried ionomer layer weighing about 2 grams per square meter of the surface portion.

8. The method of claim 1 wherein the at least one surface portion is one major planar surface of a sheet of porous, electrically conductive material.

9. The method of claim 8 wherein the one major planar surface of the sheet of porous, electrically conductive material further comprises a catalyst layer thereon.

10. The method of claim 8 wherein the ionomer-containing fluid further comprises a catalyst powder.

11. The method of claim 8 wherein the sheet of porous, electrically conductive material is a sheet of woven or non-woven carbon fiber paper.

12. The method of claim 1 wherein the at least one surface portion is one major planar surface of an ion-exchange membrane.

13. The method of claim 12 wherein the ionomer-containing fluid further comprises a catalyst powder.

14. The method of claim 1 wherein the ionomer of the ionomer-containing fluid is sulfonated perfluorocarbon ionomer.

15. The method of claim 1 wherein the ionomer-containing fluid further comprises water and an alcohol.

16. The method of claim 15 wherein the alcohol is isopropyl alcohol.
17. The method of claim 16 wherein the concentration of isopropyl alcohol ranges from 0% to 30% by weight of the ionomer-containing fluid.
18. The method of claim 15 wherein the concentration of ionomer ranges from 1% to 20% by weight of the fluid.
19. The method of claim 15 wherein the concentration of ionomer ranges from 7% to 10% by weight of the fluid.
20. The method of claim 1 wherein the gas is substantially chemically inert.
21. The method of claim 1 wherein the gas is nitrogen.
22. The method of claim 1 wherein the gas is oxygen or air.
23. The method of claim 22 wherein the ratio of air to ionomer-containing fluid is between 2:1 and 20:1.
24. The method of claim 1 wherein agitation of the mixture of the ionomer-containing fluid and the gas is performed with a mechanical agitator.
25. The method of claim 24 wherein the mechanical agitator achieves high shear agitation.

26. The method of claim 1 wherein the layer of the stable foam is applied to the at least one surface portion of the substrate by blade coating, die coating, comma bar coating, screen printing or dip coating.

27. The method of claim 1 wherein the steps of applying and drying are performed in a continuous manner.

28. The method of claim 1 wherein the steps of applying and drying are performed as a batch process.

29. An ionomer-coated substrate made according to the method of claim 1.

30. An ionomer-coated electrode substrate made according to the method of claim 8.

31. An ionomer-coated electrode made according to the method of claim 9.

32. A membrane electrode assembly comprising an ionomer-coated electrode substrate made according to the method of claim 8.

33. A fuel cell comprising an ionomer-coated substrate made according to the method of claim 8.

34. A fuel cell stack comprising an ionomer-coated substrate made according to the method of claim 8.

35. A motor vehicle comprising a fuel cell stack of claim 32.

36. A stationary or portable electrical power-generating plant comprising a fuel cell stack of claim 34.

37. A catalyst coated membrane made according to the method of claim 13.

38. A fuel cell comprising a catalyst coated membrane made according to the method of claim 37.